

AIR FORCE QUALIFICATION TRAINING PACKAGE (AFQTP)



for
UTILITIES SYSTEMS
(3E4X1)

MODULE 13
WATER SYSTEMS

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REVIEW ANSWER KEY Key-1

Career Field Education and Training Plan (CFETP) references from 1 Apr 97 version.

OPR: HQ AFCESA/CEOT

Certified by: HQ AFCESA/CEO
(Colonel Lance C. Brendel)

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for
UTILITIES SYSTEMS
(3E4X1)

INTRODUCTION

Before starting this AFQTP, refer to and read the “Trainee/Trainer Guide” located on the AFCESA Web site <http://www.afcesa.af.mil/>

AFQTPs are mandatory and must be completed to fulfill task knowledge requirements on core and diamond tasks for upgrade training. ***It is important for the trainer and trainee to understand*** that an AFQTP ***does not*** replace hands-on training, nor will completion of an AFQTP meet the requirement for core task certification. AFQTPs will be used in conjunction with applicable technical references and hands-on training.

AFQTPs and Certification and Testing (CerTest) must be used as minimum upgrade requirements for Diamond tasks.

MANDATORY minimum upgrade requirements:

Core task:

AFQTP completion
Hands-on certification

Diamond task:

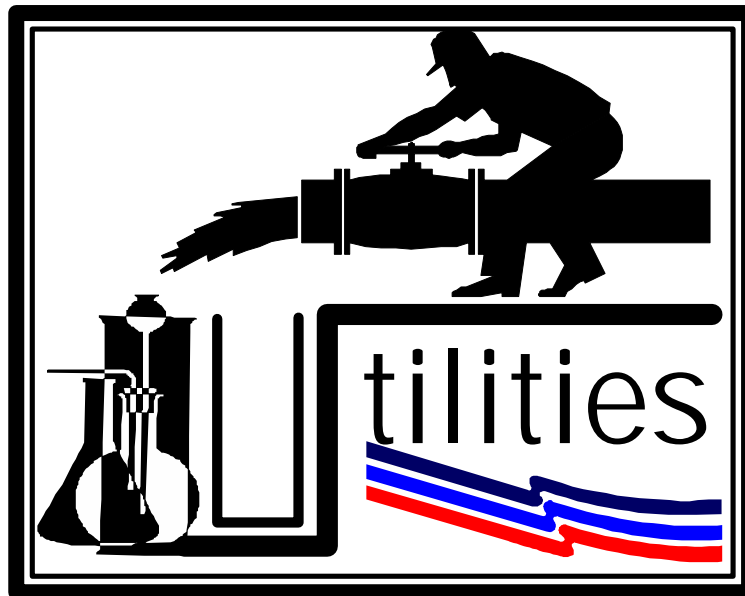
AFQTP completion
CerTest completion (80% minimum to pass)

Note: *Trainees will receive hands-on certification training for Diamond Tasks when equipment becomes available either at home station or at a TDY location.*

Put this package to use. Subject matter experts under the direction and guidance of HQ AFCESA/CEOT revised this AFQTP. If you have any recommendations for improving this document, please contact the Career Field Manager at the address below.

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PIPING

MODULE 13

AFQTP UNIT 7

INTERIOR (13.7.1.1.)

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INTERIOR

Task Training Guide

STS Reference Number/Title:	13.7.1.1., Interior
Training References:	<ul style="list-style-type: none">• CDC 3E451A• AFJMAN 32-1070• Uniformed Plumbing Code
Prerequisites:	<ul style="list-style-type: none">• Possess a 3E431 AFSC
Equipment/Tools Required:	<ul style="list-style-type: none">• General plumbing hand tools (pipe treading kit or machine, solvent welding, sweat-soldering equipment).
Learning Objective:	<ul style="list-style-type: none">• Trainee will understand the procedures to repair interior water pipe systems.
Samples of Behavior:	<ul style="list-style-type: none">• Trainee will properly repair interior water pipe systems while adhering to all safety standards.
Notes:	
<ul style="list-style-type: none">• Steps for procedure will be followed in correct sequence.• Any safety violation is an automatic failure.	

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INTERIOR

Background: Repairing broken pipes is a task that utilities specialists face daily. Because of the wide variety of materials used on piping systems, care must be taken when attempting to repair them. Leaks in a piping system require either temporary or permanent repairs. Temporary repairs are for emergency situation they should made only when correct repair parts are not immediately available. There are situations that will require you to make temporary repairs on various types of piping however, you should make permanent repairs as soon as possible. Permanent repair should be made in a manner that is just as good as the original installation.

Temporary Repairs: Repairs can be made using plastic tubing, rubber pads, rubber tape, wooden plugs, sheet-metal screws, compression couplings, and pipe repair clamps. The type of repair method you will make is directly dependent on the piping material being repaired.

Step 1: Locate the area of damaged pipe where the leak is coming from.

Step 2: Determine type of repair to be made.

Step 3: Use shut-off valves to isolate the area for the repairs.

Step 4: Remove damaged sections of piping or clean around damage section.

Step 5: Install repair clamp or compression clamp and tighten down bolts.

Step 6: Slowly turn water on and check damage section for leaks.

Permanent Repairs: As stated earlier the best type of repair for a damage section of pipe is a permanent repair. Steel unions should be the best method to use when making a permanent repair. The damaged section should be cut out (at least 4 inches from the fittings) and removed. Cutting the pipe at least four inches from a fitting gives you working room to thread a piece of pipe the same length and use it to reassemble the pipe. Cut a replacement piece of pipe and thread both ends. Make sure that you compensate for the length of the unions. A single length of pipe may be installed only when the old length of pipe is disconnected at a union. (See Figure 1)

HINT:

Use the unions to install the new section of piping.

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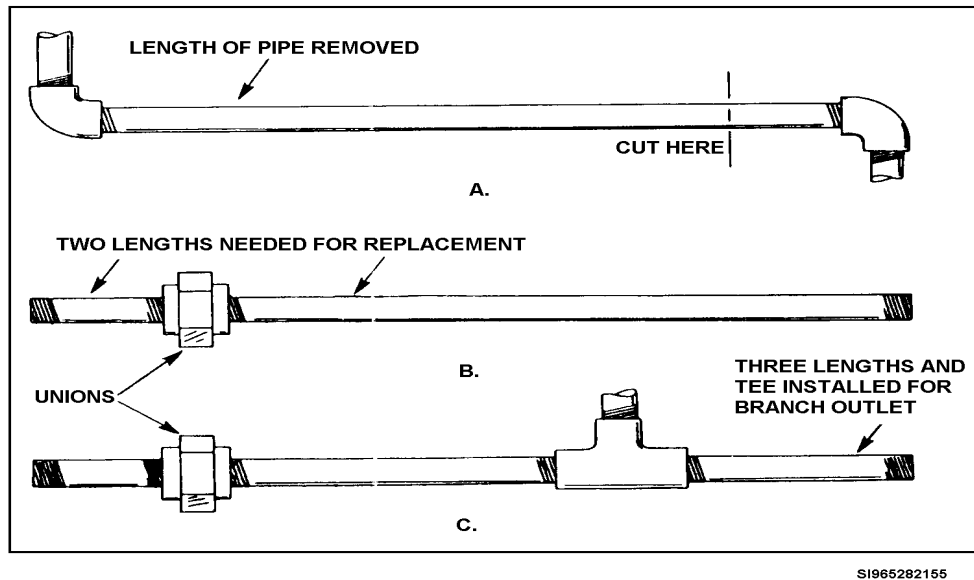


Figure 1, Installing Steel Unions

Copper. You must drain all the water from copper tubing before trying to repair it. Cut out the damaged portion of tubing with a tubing cutter or hacksaw. Design a new section of tubing using measurements from the removed damaged section. Copper couplings are used to connect the new section onto the original system. Each end of the repair tubing should have a coupling on it.

SAFETY:

BEFORE SOLDERING THE FIRE DEPARTMENT MUST INSPECT THE AREA AND ISSUE AN AF FORM 592, USAF WELDING, CUTTING AND BRAZING PERMIT. A FIRE EXTINGUISHER MUST BE PRESENT.

When a leak occurs at a soldered joint in copper tubing, drain the tubing and re-solder the joint. However, if compression type joints are used in the system, just tighten the affected ones with a wrench. When a section of copper tubing must be replaced, use slip couplings rather than brass union to connect the two pieces of tubing.

SAFETY:

WHEN REPAIRS ARE MADE TO A COPPER HOT WATER LINE, ENSURE THE HEAT SOURCE TO THE WATER HEATER IS OFF BEFORE DRAINING.

Plastic. Leaking plastic pipe and fittings are easily cut out and replaced. The procedures for replacing plastic fittings or plastic pipe are similar to that for replacing copper tubing. However, the material used will be a plastic couplings and solvent weld method of connecting them. Permanent repairs to plastic pipe are quick and easy. Cut out damage section of pipe. Make cuts as straight and square as possible.

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NOTE:

Allow the joints to dry according to manufacturer's specifications before turning the water on.

SAFETY:

BEFORE PERFORMING SOLVENT WELDING, ENSURE THE AREA IS WELL VENTILATED.

To perform repairs to interior lines, follow these steps:

Step 1: Locate broken pipe.

Step 2: Gather required material and equipment.

Step 3: Isolate broken line by turning off appropriate shut off valves.

HINT:

Most shut off valves to a building or section of a building may be found in a mechanical room. If you have to turn the water off to a section or to the entire building you must notify the building custodian/occupants.

Step 4: Cut and remove broken pipe.

Step 5: Measure the length of pipe needed to be replaced.

Step 6: Depending on which piping material you are using, install coupling or union on the section of piping to be repaired.

Step 7: Re-install new piping and joints.

NOTE:

If applying the solvent welding, allow the joints to dry according to manufacturer's specifications before turning the water on.

Step 8: Slowly turn water back on.

Step 9: Check for leaks. Correct leaks if found.

Step 10: Clean area and return material and equipment to their appropriate places.

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Review Questions for Interior

Question	Answer
1. Before soldering, what form must be submitted by the Fire Department?	a. AF Form 591 b. AF Form 592 c. AF Form 593 d. AF Form 594
2. After locating the damaged line, what must you do?	a. Answer A. b. Answer B. c. Isolate the damaged line d. Open the nearest valve
3. The procedures for replacing plastic pipe or plastic fittings are similar to what type of pipe?	a. Polyurethane b. Polyethylene c. Steel d. Copper
4. Temporary repairs are preferred rather than permanent repairs.	a. True b. False
5. Before working on hot water copper lines, what must you ensure before draining the line?	a. An extinguisher is close by b. The fire department has been notified c. the heat source is off to the water heater d. None of the above
6. When working with steel pipe, how many inches must be cut from the fitting?	a. 4 inches b. 8 inches c. 12 inches d. 16 inches
7. A permanent repair should be made in a manner that will operate as good as the original installation.	a. True b. False
8. A single length of pipe may <i>not</i> be installed only when the old length of pipe is disconnected at a union.	a. True b. False

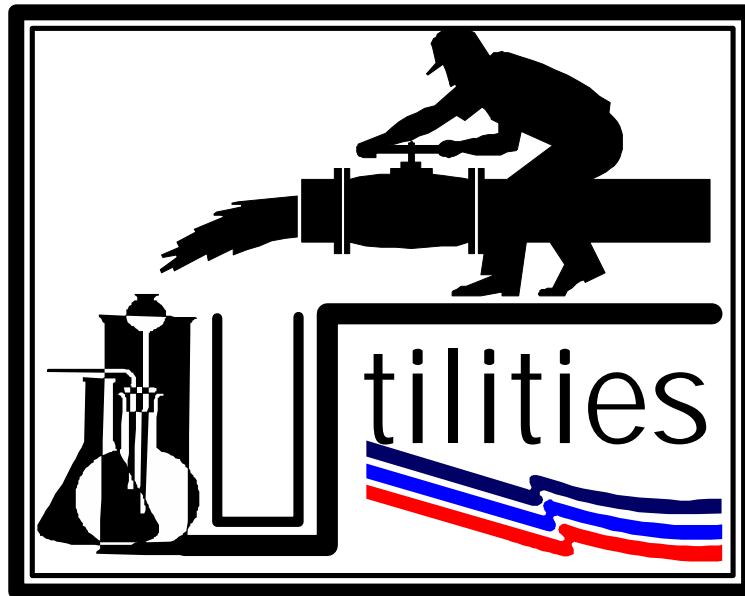
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INTERIOR

Performance Checklist		
Step	Yes	No
1. Did the trainee identify facts associated with the two types of emergency repairs? <ul style="list-style-type: none"> • Temporary • Permanent 		
2. Did the trainee take proper safety precautions? <ul style="list-style-type: none"> • Fire Department issued AF Form 592. • Fire extinguisher on site. 		
3. Did trainee follow step-by-step procedure for temporary repair? <ul style="list-style-type: none"> • Located the area of damaged pipe where the leak is coming from. • Determined type of repair to be made. • Used shut-off valves to isolate the area for the repairs. • Removed damaged sections of piping or clean around damage section. • Installed repair clamp or compression clamp and tighten down bolts • Slowly turned water on and check damage section for leaks. 		
4. Did trainee follow step-by-step procedure for permanent repair? <ul style="list-style-type: none"> • Locate broken pipe. • Gather required material and equipment. • Isolate broken line by turning off appropriate shut off valves. • Cut and remove broken pipe. • Measure the length of pipe needed to be replaced. • Depending on which piping material you are using, install coupling or union on the section of piping to be repaired. • Re-install new piping and joints. • Turn water on. • Check for leaks. Correct leaks if found. • Clean area and return material and equipment to their appropriate places. 		
5. Did the trainee understand how to repair interior water pipe system according to the type of material being used? <ul style="list-style-type: none"> • Copper • Plastic • Steel 		
6. Did the trainee complete all the questions in QTP? <ul style="list-style-type: none"> • Score 80% or higher. • Did trainer review and explained all missed questions. 		
7. Did the trainee take proper safety precautions?		

FEEDBACK: Trainer should provide both positive and/or negative feedback to the trainee immediately after the task is performed. This will ensure the issue is still fresh in the mind of both the trainee and trainer.

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PIPING

MODULE 13

AFQTP UNIT 7

EXTERIOR (13.7.1.2.)

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EXTERIOR

Task Training Guide

STS Reference Number/Title:	13.7.1.2., Exterior
Training References:	<ul style="list-style-type: none">• CDC 3E451A• AFJMAN 32-1070• Uniformed Plumbing Code• AWWA Video, Distribution Systems Leak Detection and Repair
Prerequisites:	<ul style="list-style-type: none">• Possess a 3E431
Equipment/Tools Required:	<ul style="list-style-type: none">• General Plumbing Hand tools, Soldering Kit or Torch if needed
Learning Objective:	<ul style="list-style-type: none">• Trainee will understand the steps to repair exterior water pipe system.
Samples of Behavior:	<ul style="list-style-type: none">• Trainee will properly repair exterior water pipe system while adhering to all safety standards.
Notes:	
<ul style="list-style-type: none">• Steps for procedure will be followed in correct sequence.• Any safety violation is an automatic failure.	

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EXTERIOR

Background: There are several reasons for making temporary repairs. Temporary repairs will minimize the down time for customers to go without water. If the water has to be off for a long period of time, fire protection is jeopardized. The loss of water is minimized with temporary repairs.

There are factors and situations that require you to make temporary repairs until a more permanent repair can be made. *REMEMBER* that permanent repairs are preferred over temporary repairs. Each type of piping has different fittings and procedures that are used when making a repair. See Figure 1.

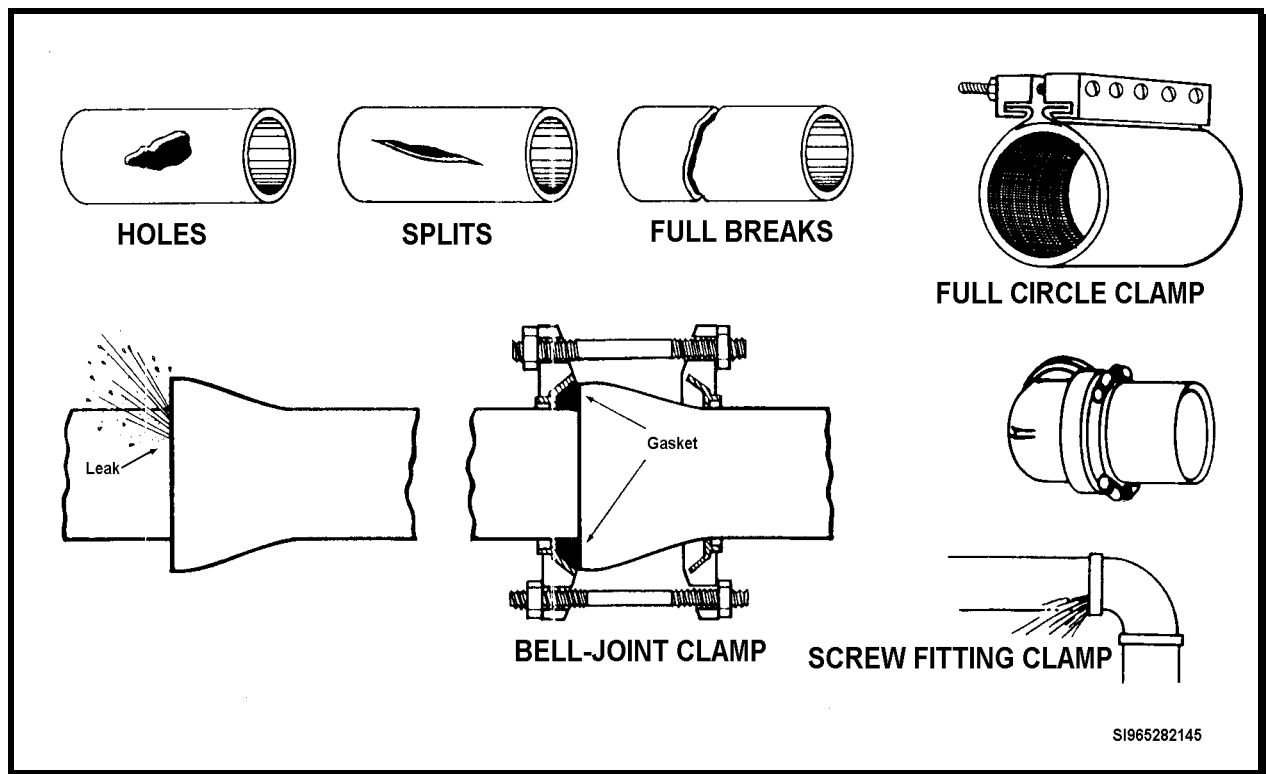


Figure 1, Types of Exterior Main Breaks and Repair Devices

Steel. Using an emergency pipe clamp can temporarily repair steel pipe. When replacing fitting or piping on a steel system, the defective section is cut out and discarded. Cut the pipe at least four inches from a fitting, then unscrew the ends. Cutting the pipe at least four inches from a fitting gives you working room to thread a piece of pipe the same length and use it to reassemble the pipe. The new section of pipe is made of two lengths of pipe, with a union in the middle for quick and easy assembly. A single length of pipe may be installed only when the old length of pipe is disconnected at a union.

NOTE:

Unions can not be buried or installed underground.

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Copper. Temporary repairs on copper tubing should be made using a pipe clamp. When leaks occur at a soldered joint in copper tubing, drain the tubing and re-solder the joint. If the joint doesn't take solder or you can't get all the water drained away from the fitting you'll have to replace the section of pipe or fitting. However, if compression type joints are used in the system, tighten the affected ones with a wrench. When a section of copper tubing has to be replaced, use copper sweat or forged brass couplings rather than a brass union.

Plastic. Pipe clamps, full circle clamps, or compression-type couplings are used to make temporary repairs on plastic pipe. The procedures for replacing plastic fittings or plastic pipe is similar to that for replacing steel piping but the material used will be a plastic coupling and you will use the solvent weld method of connecting them.

Cast Iron. Full circle clamps and split repair clamps are two means of temporarily repairing cast iron pipe. These clamps usually come in 6 to 30 inches. Use compression couplings when replacing a section of damaged pipe onto the system. Slide the follower onto pipes, slide gaskets onto pipes, then slide middle ring onto pipe and place repair section of pipe into position. Slide the middle ring back until it is centered between the pipe and the repairing piping. Slide gaskets and followers up the middle ring. Install bolts and hand tight then use wrench to tighten bolts in a criss-cross method. A install a compression coupling on each end of the repair piping.

NOTE:

This is a general step-by-step task procedure.

REFER TO VIDEO: *Distribution Systems Leak Detection and Repair By: American Water Works Association. To help you understand leak detection procedures, isolation, and general repair procedures. To perform exterior pipe repairs, follow these steps:*

- Step 1:** Notify customers of water outage and estimated completion time.
- Step 2:** Isolate flow to damaged pipe by closing appropriate valves.
- Step 3:** Ensure an AF FORM 103, Work Clearance Request has been approved before digging.
- Step 4:** Dig trenches and utilize shoring equipment.

NOTE:

Shoring is needed in 4 feet in loose soil and 5 feet in hard soil.

- Step 5:** Expose damaged line.
- Step 6:** Clean areas of the damaged line that needs to be replaced.
- Step 7:** Cut and remove damaged section from pipe system.

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HINT:

REMEMBER: If working with steel, the damaged section should be cut out at least 4 inches from the fittings.

Step 8: Measure the length of pipe to be replaced.

HINT:

A transitional coupling can be used when replacing two different types of pipe (i.e. PVC to cast-iron or galvanized).

Step 9: Install coupling or repair clamps on new replacement section and install into the pipe system. Compression couplings will be needed on larger lines (such as 2 inches and above).

Step 10: Install new piping and determine the requirements for superchlorinating of the new section. Bio-environmental will advise on procedure and chlorine amounts.

Step 11: Tighten unions, couplings, or compression fittings.

Step 12: Slowly turn water to pipe system on.

Step 13: Check for leaks.

Step 14: Flush line through nearest hydrant to rid debris and remaining chlorine.

Step 15: Correct leaks by tightening unions, couplings, or compression couplings.

Step 16: Cover trench with 6-inch layers of soil at a time and compact each layer.

Step 17: Clean area and return equipment.

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Review Questions for Exterior

Question	Answer
1. Using an emergency _____ can temporarily repair steel pipe.	a. Coupling b. Pipe clamp c. Union d. None of the above
2. Full circle clamps and _____ clamps are two means of temporarily repairing cast iron pipe.	a. Split repair b. Temp repair c. Full repair d. Long patch
3. A _____ of pipe may be installed only when the old length of pipe is disconnected at a union.	a. Double step b. Double length c. Single step d. Single length
4. What type of coupling is to repair cast-iron pipe?	a. Compression b. Split repair c. Compact d. Full repair
5. What method is used to tighten a compression coupling?	a. Full torque b. Low torque c. Criss-cross method d. None of the above
6. What AF Form must be submitted and approved before digging or trenching?	a. AF Form 101 b. AF Form 102 c. AF Form 103 d. AF Form 104
7. When is shoring equipment needed in loose soil?	a. 4 Feet b. 8 feet c. 12 feet d. 16 feet
8. You should always cover trench excavation with proper filler in 6 inch compact layers of soil.	a. True b. False

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EXTERIOR

Performance Checklist		
Step	Yes	No
1. Did the trainee identify facts associated with the two types of emergency repairs? <ul style="list-style-type: none"> • Temporary • Permanent 		
2. Did trainee follow step-by-step procedure for permanent repair? <ul style="list-style-type: none"> • Notified customers of water outage and estimated completion time. • Isolated flow to damaged pipe by closing appropriate valves. • Ensured an AF FORM 103, was approved before digging. • Excavated trenches and utilize shoring equipment. • Exposed damaged line. • Cleaned areas of the damaged line that needed to be replaced. • Cut and removed damaged section from pipe system. • Measured the length of pipe to be replaced. • Installed coupling or repair clamps on new replacement section and install into the pipe system. • Installed new piping and determined the requirements for superchlorinating of the new section. • Tightened unions, couplings, or compression fittings. • Slowly turned water to pipe system on. • Checked for leaks. • Flushed line through nearest hydrant to remove debris and remaining chlorine. • Corrected leaks by tightening unions, couplings, or compression couplings. • Covered trench with 6-inch layers of soil and compacted each layer. • Cleaned area and returned equipment. 		
3. Did the trainee complete all the questions in QTP? <ul style="list-style-type: none"> • Score 80% or higher. • Did trainer review and explained all missed questions. 		
4. Did the trainee take proper safety precautions?		

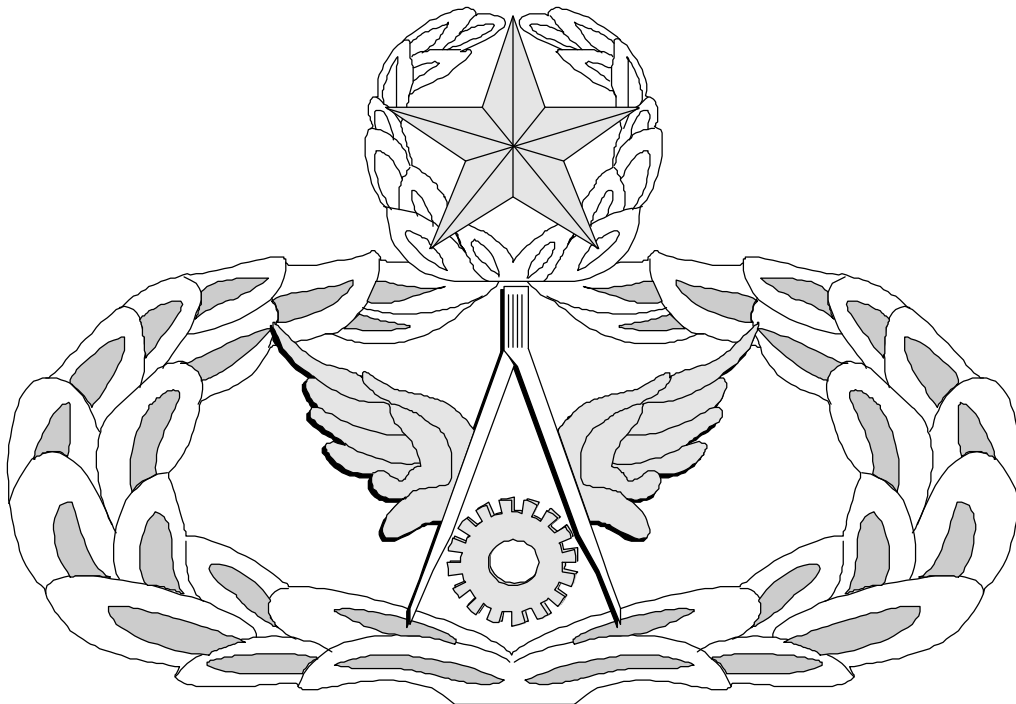
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Air Force Civil Engineer

QUALIFICATION TRAINING PACKAGE (QTP)

REVIEW ANSWER KEY



For
UTILITIES SYSTEMS

(3E4X1)

MODULE 13
WATER SYSTEMS

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Key-1

INTERIOR

(3E4X1-13.7.1.1.)

Question	Answer
1. Before soldering, what form must be submitted by the Fire Department?	b. AF Form 592
2. After locating the damaged line, what must you do?	c. Isolate the damaged line
3. The procedures for replacing plastic pipe or plastic fittings are similar to what type of pipe?	d. Copper
4. Temporary repairs are preferred rather than permanent repairs.	b. False
5. Before working on hot water copper lines, what must you ensure before draining the line?	c. the heat source is off to the water heater
6. When working with steel pipe, how many inches must be cut from the fitting?	a. 4 inches
7. A permanent repair should be made in a manner that will operate as good as the original installation.	a. True
8. A single length of pipe may <i>not</i> be installed only when the old length of pipe is disconnected at a union.	b. False

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EXTERIOR

(3E4X1-13.7.1.2.)

Question	Answer
1. Using an emergency _____ can temporarily repair steel pipe.	b. Pipe clamp
2. Full circle clamps and _____ clamps are two means of temporarily repairing cast iron pipe.	a. Split repair
3. A _____ of pipe may be installed only when the old length of pipe is disconnected at a union.	d. Single length
4. What type of coupling is to repair cast-iron pipe?	a. Compression
5. What method is used to tighten a compression coupling?	c. Criss-cross method
6. What AF Form must be submitted and approved before digging or trenching?	c. AF Form 103
7. When is shoring equipment needed in loose soil?	a. 4 Feet
8. You should cover trench excavation with proper filler in 6 inch compact layers of soil.	a. True

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